

HUC 07110005 – North Fork Salt
Water body ID: 3960 (formerly 0115U-01)
Pollutant(s): Unknown



Total Maximum Daily Load Implementation Strategies

for

**Bear Creek
Adair County**

Impairment: Unknown

Completed: January 15, 2020

Water Body Summary

Pollutant: Unknown

Name: Bear Creek

Location: Adair County near Kirksville

8-digit Hydrologic Unit Code (HUC):¹

07110005 – North Fork Salt

12-digit HUC Subwatersheds:

071100050108 – Upper Bear Creek

Water Body Identification Number (WBID) and Hydrologic Class:²

WBID 3960³ (0115U-01)⁴ – Class C

Designated Uses:⁵

Irrigation

Livestock and wildlife protection

Warm water habitat

Human Health Protection

Whole body contact recreation category B

Secondary contact recreation

Impaired Use:

Warm water habitat⁶

Pollutant Identified on the 2008 303(d) List:

Unknown

Identified Source on the 2008 303(d) List:

Unknown

Length and Location of Impaired Segment:

8.43 miles from Section 08, Township 61N, Range 14W to south Kirksville in Section 22, Township 62N, Range 15W.

¹ The U.S. Geological Survey uses a nationwide system based on surface hydrologic features to delineate watersheds. This system divides the country into 2,270 8-digit hydrologic units (USGS 2019).

² For hydrologic classes see 10 CSR 20-7.031(1)(F). Class C streams may cease flow in dry periods but maintain permanent pools which support aquatic life.

³ 10 CSR 20-7.031(1)(Q) defines the Missouri Use Designation Dataset (MUDD) which documents the names and locations of the state's rivers, streams, lakes, and reservoirs which have been assigned designated uses. The MUDD includes rivers, streams, lakes, and reservoirs that were not assigned designated uses or WBIDs prior to November 6, 2013, and that are included within the 100,000-scale (100k) extent of the National Hydrography Dataset (NHD) in the state. The MUDD streams are listed at the top of Table H as 100k Extent-Remaining Streams are Class C (10 CSR 20-7.031(1)(F)), and have all been assigned WBID 3960.

⁴ Bear Creek was listed on the 1994/1996 Missouri 303(d) List of impaired waters but was not assigned a WBID.

In 1998, Bear Creek was not included on the 303(d) List. Bear Creek was listed on the 2002 303(d) List once again but was not assigned a WBID. On the 2004/2006 list, Bear Creek was assigned a WBID of 0115U (based upon the WBID of the downstream segment of Bear Creek which is WBID 0115), and in the 2008 303(d) List it was assigned WBID 0115U-01.

⁵ For designated uses see 10 CSR 20-7.031(1)(C) and 10 CSR 20-7.031 Table H. Presumed uses are assigned per 10 CSR 20-7.031(2)(A) and (B) and are reflected in the Missouri Use Designation Dataset described at 10 CSR 20-7.031(2)(E).

⁶ Original impairment listing in 2008 was based on violations of Missouri's general criteria since no uses were designated to this stream at that time

TABLE OF CONTENTS

1. Introduction.....	3
2. Targeted Participants and Potential Roles in Implementation.....	5
3. Why is a TMDL Needed for Stinson Creek?.....	6
4. Review of Sources Identified in the TMDL Report.....	7
5. Existing Loads and Needed Reductions	7
6. Implementation of the TMDL.....	7
7. Costs and Potential Funding Sources.....	16
8. Measurable Goals, Timeline and Milestones.....	18
9. Conclusion	19
10. References.....	20
Appendix A. Nine Key Elements Critical to a Watershed Management Plan.....	21

1. Introduction

A total maximum daily load (TMDL) identifies water quality problems, possible causes of those problems, and provides targets for restoration. However, actual water quality improvements are often dependent upon voluntary actions and support from local communities and landowners residing within the watershed. This implementation strategies document is a companion to the TMDL report and provides supplemental information about actions that will implement the goals established in the revised Bear Creek TMDL. These strategies provide a general guide to permit writers, nonpoint source program coordinators, and other Missouri Department of Natural Resources staff, as well as soil and water conservation districts, local governments, permitted entities, regional planning commissions, watershed managers, and citizen groups for achieving the wasteload and load allocations established in the TMDL. Reducing current pollutant loading to the allocations established in the TMDL will result in the water body attaining its designated warm water habitat use for the protection of aquatic life. In this way, the TMDL serves as a “pollutant diet” for maintaining the environmental health of the stream. Figure 1 presents the location of the impaired water body and its watershed. Background, watershed information, and specific pollutant loading targets and water quality objectives for the impairment of Bear Creek can be found in the 2019 Revised Bear Creek TMDL. Both documents are available on the Department’s website at dnr.mo.gov/env/wpp/tmdl/0115u-01-bear-ck-record.htm. Questions regarding the TMDL may be sent via email to tmdl@dnr.mo.gov or by calling the Department’s Watershed Protection Section at 573-751-5723.

This document neither prescribes nor prohibits any specific practices or technologies for reducing pollutant loading in the impaired water body and is not intended to serve as the sole means of remediation and restoration. However, the Department recognizes that technical guidance and support are critical to achieving the goals of any TMDL. Therefore, while the TMDL calculates the maximum pollutant loading that the impaired stream can assimilate and still meet water quality standards, this strategies document provides additional information to assist in meeting the TMDL loading goals, including best management practices (BMPs), treatment technologies, potential participants in the watershed, funding sources, and calculations of pollutant reductions.

Because the TMDL addresses pollutant loading from all potential sources in the watershed, this strategies document provides guidance for meeting the established loading targets assigned to both point and nonpoint sources.⁷ The Clean Water Act regulates point sources of pollution. Any necessary reductions in pollutant loading from these sources are completed through the Missouri State Operating Permit program. Nonpoint sources of pollution are not regulated through permits and any reductions from these sources will rely on the voluntary implementation of BMPs in the watershed. Local communities and citizens looking to develop organized watershed groups to improve water quality are encouraged to contact the University of Missouri Extension at 573-882-0085. Information regarding the University Extension’s water quality program is available online at fsb.missouri.edu/extension/waterquality/.

⁷ Point and nonpoint sources are defined and discussed in Sections 6.1 and 6.2 of the 2019 revised Bear Creek TMDL. Specific water quality goals associated with these sources are found in Sections 9 and 10 of the TMDL.

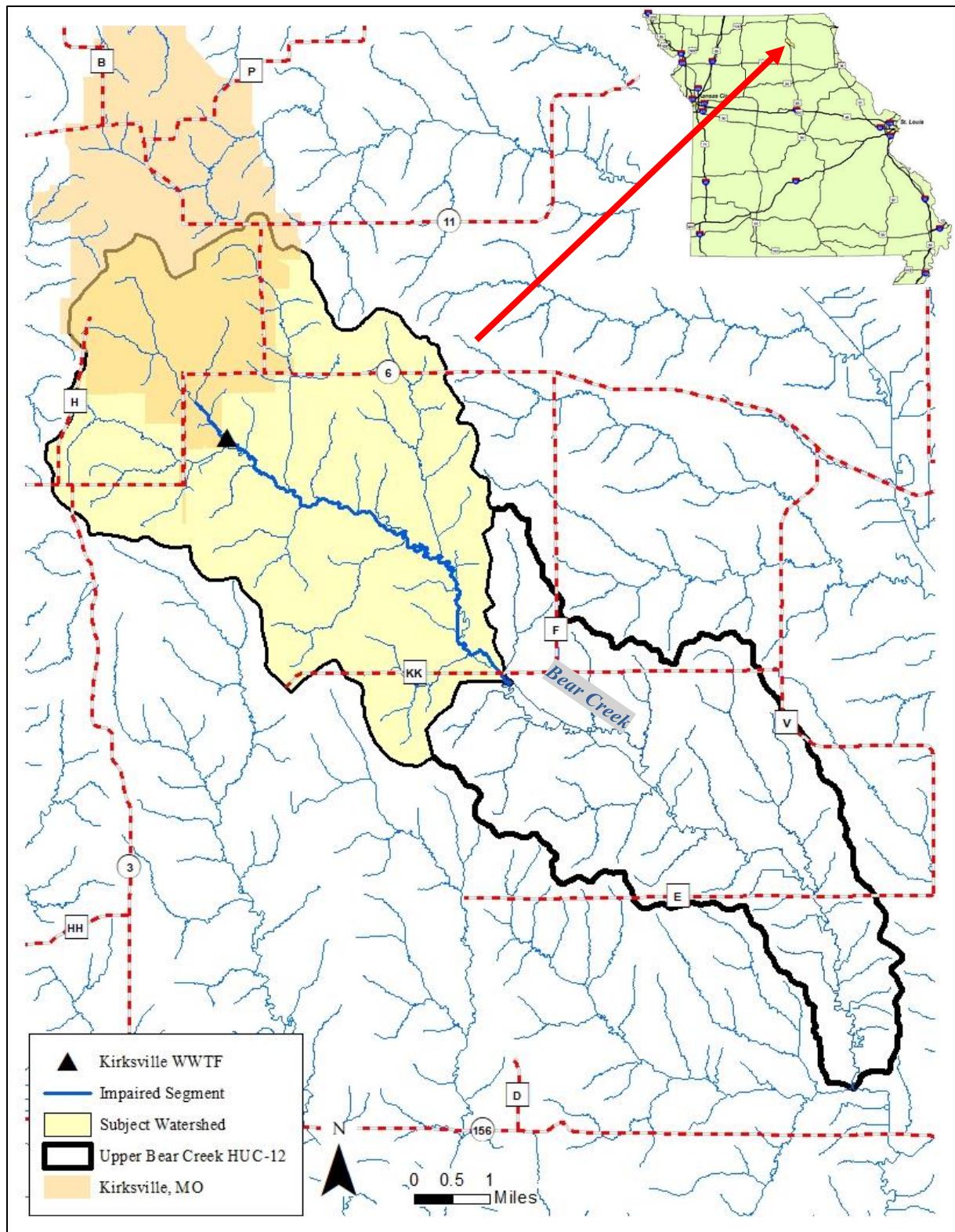


Figure 1. The Upper Bear Creek watershed

2. Targeted Participants and Potential Roles in Implementation

The Department implements TMDL targets for point sources through the Missouri State Operating Permit program. For nonpoint sources, private landowners and citizen groups voluntarily implement water quality improvement projects and cost-share practices, which may be funded in part by grants or subgrants from the Department's Section 319 Nonpoint Source Implementation Program and the Soil and Water Conservation Program. Local governments, citizen groups, and individuals who have an interest in improving water quality in their communities may implement additional water quality improvement actions. Successfully meeting the goals of the TMDL requires participation and cooperation from the various parties within the watershed. Participant roles range from technical support to actual on-the-ground implementation of BMPs. Groups and agencies that may potentially be involved in the TMDL implementation process are identified below along with descriptions of their possible roles. This list is not exhaustive and not intended to compel participation from any organizations; nor is it meant to exclude those who are not listed, but may be interested in participating.

- Department of Natural Resources
 - Administers statutory authorities granted by Missouri clean water law
 - Ensures permits issued in the watershed are consistent with the assumptions and requirements of TMDL wasteload allocations (the allowable point source load)
 - Provides compliance assistance to regulated entities
 - Provides technical support to locally-led watershed groups
 - Serves as a potential source of financial assistance for watershed plan development and BMP implementation through Sections 319(h) and 604(b) grants, or through Soil and Water Program cost-share practices
 - Serves as a potential source of financial assistance for infrastructure improvements through low-interest State Revolving Fund loans
 - Assesses attainment of water quality standards on a biennial basis for Clean Water Act Sections 303(d) and 305(b) reporting
 - Provides education and training to volunteers through the Missouri Stream Team Program⁸
- County Soil and Water Conservation Districts
 - Provide financial incentives to agricultural producers to implement conservation practices that help prevent soil erosion and protect water quality
 - Provide technical assistance with design, implementation, and maintenance of conservation practices
- University of Missouri Extension
 - Provides technical assistance for addressing nonpoint source and watershed management issues
 - Assists with organizing locally led watershed groups
- Missouri Department of Conservation

⁸ The Missouri Stream Team Program is a partnership between the Department of Natural Resources, the Department of Conservation, the Conservation Federation of Missouri, and the citizens of Missouri. The Stream Team Program provides an opportunity for all citizens to get involved in river conservation. Additional information regarding the Stream Team program is available online at mostreamteam.org.

- Provides technical assistance with stream and watershed management issues
- Promotes maintenance and reestablishment of stable streambanks and functional riparian corridors
- Missouri Department of Health and Senior Services
 - Provides technical assistance pertaining to onsite wastewater treatment systems (i.e., septic)
- County Health Departments
 - Provide technical assistance pertaining to onsite wastewater treatment systems
- Kirksville Wastewater Treatment Facility
 - Operate in accordance with stated permit limits, conditions and schedules
- Kirksville Municipal Separate Storm Sewer System (MS4)
 - Operate in accordance with stated permit conditions and schedules
- Locally led watershed groups
 - Develop and implement Section 319-funded nine key element watershed-based plans.⁹
(See Appendix A)
 - Identify critical areas at a local level
 - Implement BMPs to reduce nonpoint source pollutant loading
 - Provide public education and outreach
- Stream Team volunteers
 - Collect screening level water quality data (i.e., dissolved oxygen and biological monitoring) through the Volunteer Water Quality Monitoring program
 - Provide stewardship, advocacy, and education
- Citizens living and working within the watershed
 - Voluntarily implement structural and nonstructural BMPs on private lands, residences, and businesses, such as limiting fertilizer use, maintaining septic systems, conserving water, controlling erosion, limiting runoff, and managing manure

3. Why is a TMDL Needed for Bear Creek?

Section 303(d) of the federal Clean Water Act and Title 40 of the Code of Federal Regulations Part 130 require states to develop TMDLs for water bodies not meeting applicable water quality standards. Missouri's Water Quality Standards consist of three major components: designated uses, water quality criteria, and an antidegradation policy. Descriptions of each of these components are located Section 4 of the 2019 Revised Bear Creek TMDL. Bear Creek is not attaining designated aquatic life protections for warm water habitat due to low fish and benthic macroinvertebrate diversity. See Section 5 of the revised Bear Creek TMDL for more information.

⁹ Guidance for developing a successful watershed-based plan that incorporates the U.S. Environmental Protection Agency's nine minimum elements is available online at www.epa.gov/nps/handbook-developing-watershed-plans-restore-and-protect-our-waters. These nine elements are required for plans funded with incremental Clean Water Act section 319 funds and are recommended for inclusion in all other watershed plans.

4. Review of Sources Identified in the TMDL Report

Section 6 of the 2019 revised Bear Creek TMDL contains a comprehensive inventory and assessment of all known and suspected sources in the watershed that may be contributing to low fish and benthic macroinvertebrate diversity in Bear Creek. The sources identified in the TMDL are based on issued permits and a general knowledge of watershed conditions. Specific loading contributions from each source are not always known; therefore, groups interested in implementing BMPs in the watershed may want to consider employing additional data collection efforts such as edge-of-field monitoring or sediment studies. See Table 1 for a list of the potential sources identified in the TMDL report.

Table 1. Potential sources contributing to low fish and benthic macroinvertebrate diversity in Bear Creek

Point Sources	Nonpoint Sources
<ul style="list-style-type: none"> • City of Kirksville Wastewater Treatment Facility <ul style="list-style-type: none"> ◦ Treated domestic wastewater ◦ Untreated or partially treated wastewater discharged as bypasses or sanitary sewer overflows • City of Kirksville municipal separate storm sewer system <ul style="list-style-type: none"> ◦ Lawn fertilizers, compost, pet and wildlife wastes • Illicit straight pipe dischargers <ul style="list-style-type: none"> ◦ Untreated domestic wastes 	<ul style="list-style-type: none"> • Onsite wastewater treatment system failures <ul style="list-style-type: none"> ◦ Untreated or partially treated domestic wastes • Agricultural stormwater runoff <ul style="list-style-type: none"> ◦ Fertilizers; livestock and wildlife wastes • Riparian conditions <ul style="list-style-type: none"> ◦ Lack of canopy (shade) ◦ Leaf litter (nutrients) ◦ Lack of vegetation (erosion)

5. Existing Loads and Needed Reductions

Current pollutant loading to Bear Creek results in conditions that reduce dissolved oxygen concentrations in the stream to levels that harm aquatic life. Additionally, current sediment loading into Bear Creek likely contributes to habitat degradation that also impairs aquatic life. To address the water quality impairment in Bear Creek, TMDL loading targets were developed for various pollutants known to contribute to poor fish and benthic macroinvertebrate habitat,

including biochemical oxygen demand (BOD), ammonia as nitrogen, total nitrogen, and total phosphorus. The TMDL also included targets for total suspended solids to address sediment loading in the stream. Reducing current pollutant loads to the loads specified and allocated to point and nonpoint sources in the TMDL will result in attainment of water quality standards.

Table 13 in Section 8 of the revised TMDL provides loading targets at low flow conditions when the Kirksville Wastewater Treatment Facility is the primary source of stream flow. This loading represents reductions from point sources in the watershed as well as a 30 percent reduction of pollutant loading from nonpoint sources. For total suspended solids, no observed data is available to determine an estimate of the amount of reduction necessary to attain water quality standards. However, a total suspended solids concentration value of 15 mg/L is targeted at all flows.

6. Implementation of the TMDL

TMDLs provide useful information for setting water quality goals and determining appropriate actions for pollutant reductions. Progress towards meeting water quality standards is expected to be long-term. In general, initial TMDL implementation is typically a continuation of already existing or planned activities, such as permits or Soil and Water Conservation Program cost-share practices. Except in cases where activities and schedules are required by legally binding requirements, such as established permit conditions, an adaptive implementation

approach that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities should be used.

6.1 Point Source Implementation

Federal regulations at 40 CFR §122.44(d)(1)(vii)(B) require permit conditions to be consistent with the assumptions and requirements of TMDL wasteload allocations. How these conditions are expressed can vary depending upon the pollutant and nature of the discharge. Although TMDLs are required to be written for daily time increments, permit effluent limits may be written in a form that derives from and complies with applicable water quality standards that use any time measure (40 CFR 122.44(d)(1)(vii)(A) and EPA 2006). The Department's permit writers have discretion for how TMDL wasteload allocations are expressed in a permit and for determining appropriate implementation schedules. Permit writers should consult available permit writing handbooks and technical support documents to determine appropriate limits.¹⁰ Although wasteload allocations are often specified for individual facilities, in some cases, it may be appropriate for pollutant loadings to be shifted between the individual facilities during permitting as long as the sum of the wasteload allocations remains unchanged and is not exceeded. In no case does a TMDL wasteload allocation allow for permit limits that exceed water quality standards. If water quality standard revisions result in criteria more stringent than an established TMDL wasteload allocation, then the more stringent criteria should be used in deriving the permit limits.¹¹ Information regarding the Department's permitting process is available online at dnr.mo.gov/env/wpp/permits/index.html or by calling the Department's Operating Permit Section at 573-522-4502.

Table 2 lists the types of point sources in the Bear Creek watershed that should be addressed in order to achieve the TMDL wasteload allocation targets. Point sources assigned a wasteload allocation in the TMDL include the city of Kirksville Wastewater Treatment Facility and the Kirksville MS4. Therefore, limiting pollutant concentrations to those consistent to meet the specified wasteload allocations identified in the revised TMDL will, in conjunction with nonpoint source reductions, result in attainment of water quality standards. Should water quality standards be attained before all pollutant wasteload allocations have been achieved, then no additional pollutant reductions will be required. The ultimate goal of the TMDL is to attain water quality standards. Pollutant reductions from the wastewater treatment facility can be achieved through enhanced treatment technologies. For the MS4, the development and implementation of an Assumptions and Requirements Attainment Plan (ARAP) should be developed. Such a plan should identify BMPs or education efforts to address pollutant loading during low flow conditions when lawn irrigation or other non-stormwater flows contribute to the impairment of Bear Creek. Management practices to reduce sediment loading during wet and dry weather conditions may be necessary to meet the total suspended solids goals of the TMDL. Additionally, addressing conditions influencing stream temperature (i.e., impervious surfaces, riparian vegetation), are recommended as these will aid in addressing the poor habitat condition. Other point sources in the watershed that are not specifically allocated a portion of the total loading capacity should continue to operate in compliance with existing permit limits and conditions.

¹⁰ The Department maintains a Water Pollution Control Permit Manual to provide guidance to permit writing staff and is available online at dnr.mo.gov/env/wpp/permits/manual/. Additionally the EPA maintains a National Pollutant Discharge Elimination System (NPDES) Permit Writers' Manual online at epa.gov/npdes/npdes-permit-writers-manual.

¹¹ Federal regulations at 40 CFR 131.21, also known as the "Alaska Rule," require water quality standards to be approved by the EPA before they can be used for Clean Water Act purposes (i.e., water quality-based effluent limitations or TMDLs).

This will maintain pollutant loading from these sources at existing concentrations, which is expected to be protective of water quality standards and result in pollutant loading that will not exceed the sum of the TMDL wasteload allocations. Any unpermitted illicit straight pipe dischargers in the waters are illegal and must be eliminated.

Table 2. TMDL implementation for point sources in the Bear Creek watershed

Point Source	Objective	Strategies
Kirksville Wastewater Treatment Facility (domestic wastewater)	Meet BOD, nitrogen, and phosphorus wasteload allocation targets stated in the 2019 Revised Bear Creek TMDL.	<ul style="list-style-type: none"> Consider no discharge options Enhanced nutrient removal Reduce occurrences of sanitary sewer overflows
Kirksville MS4	Develop ARAP and implement BMPs	<ul style="list-style-type: none"> BMPs to reduce erosion Reduce pet waste Reduce impervious surfaces
Other permitted point sources	Maintain existing pollutant loadings	<ul style="list-style-type: none"> Maintain compliance with existing permit limits and conditions
Illicit straight pipe discharges	Illegal discharges and therefore must be eliminated from the watershed	<ul style="list-style-type: none"> Report known discharges to local county health departments

6.2 Nonpoint Source Implementation

The Department does not regulate nonpoint sources through permits. Nonpoint source loading is reduced using voluntary BMPs to improve land use practices that may contribute pollutant loads to impaired water bodies. Nonpoint source load reductions can be achieved at any location in the watershed; however, targeted projects by locally led watershed groups and local governments using a nonpoint source watershed-based plan may be more effective in restoring water quality. The Department supports the development and implementation of nonpoint source watershed-based management plans through competitive EPA funded subgrants. More information about the Department's Section 319 Nonpoint Source Implementation Program is available online at dnr.mo.gov/env/swcp/nps/index.html or by calling 573-751-4932.

A land cover analysis was completed using the 2011 National Land Cover Database published by the USGS (Homer et al. 2015). Land cover calculations are summarized in Table 3. The predominance of hay and pasture lands (58.6 percent) increase the likelihood of nutrient transport from nonpoint sources (i.e., overland flow) into Bear Creek. Figure 2 depicts the distribution of the land coverage throughout the subject watershed.

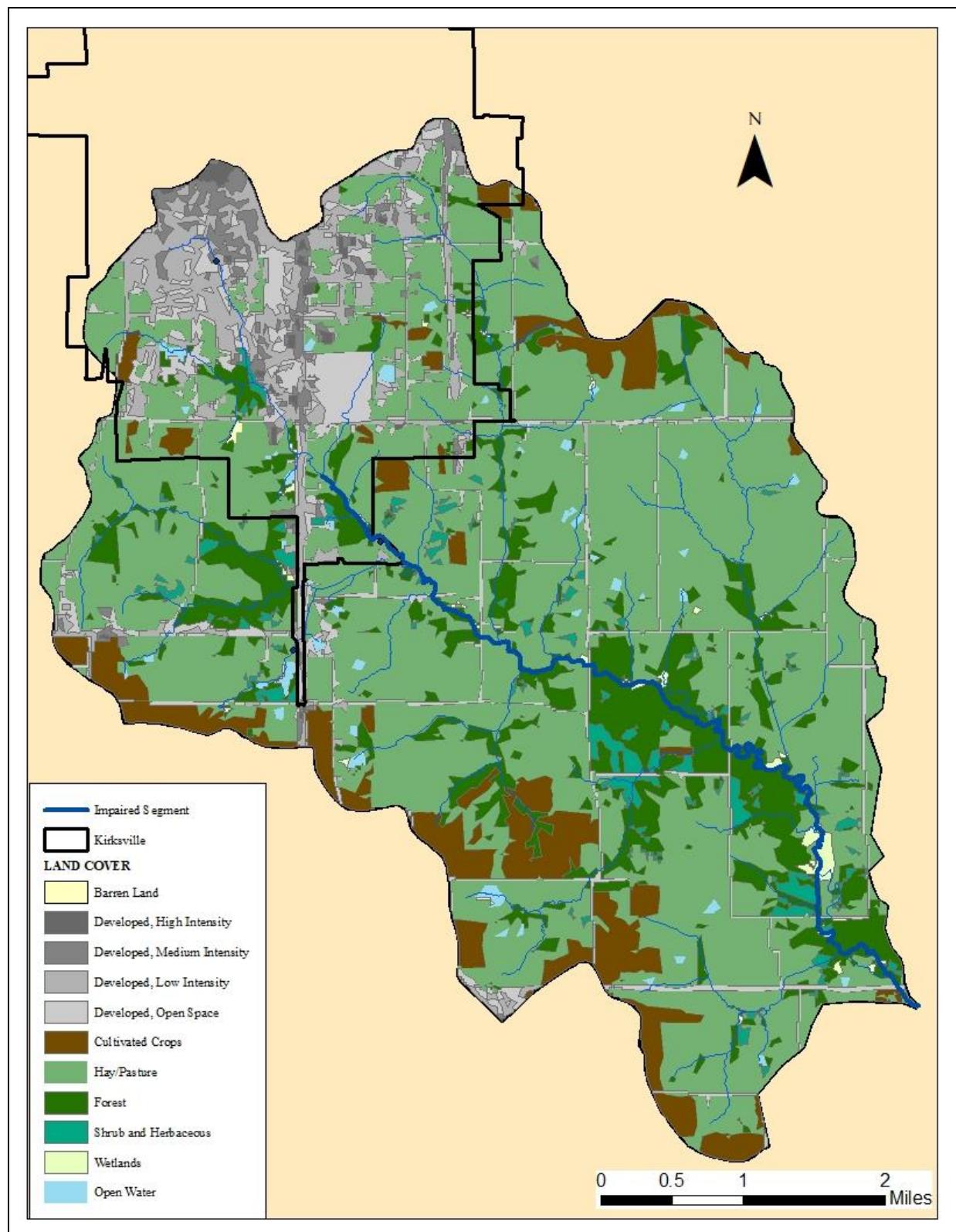


Figure 2. Land Cover in the Subject Watershed of Bear Creek

Table 3. Land cover in the subject watershed of Bear Creek

Land Cover	Area (mi ²)	Percent
Barren Land	0.009	0.04%
Developed, High Intensity	0.088	0.35%
Developed, Medium Intensity	0.488	1.92%
Developed, Low Intensity	1.62	6.36%
Developed, Open Space	1.85	7.27%
Cultivated Crops	2.11	8.29%
Hay and Pasture	14.92	58.60%
Forest	3.51	13.79%
Shrub and Herbaceous	0.535	2.10%
Wetlands	0.136	0.53%
Open Water	0.196	0.77%
Total	25.46	100%

As discussed in Section 6.2 of the 2019 revised Bear Creek TMDL report, nonpoint sources identified as potential contributors to poor fish and benthic macroinvertebrate habitat in Bear Creek include stormwater runoff from agricultural areas, onsite wastewater treatment systems, and area with poor riparian corridor conditions. Nonpoint sources primarily contribute pollutant loads through stormwater runoff and erosion at flows influenced by precipitation events. This loading can accumulate in the water body and contribute poor habitat conditions. To meet target load allocations, BMPs that reduce runoff and surface erosion are the primary means for achieving pollutant reductions from nonpoint sources. However, failing onsite wastewater treatment systems and direct waste inputs from animals that are not excluded from waterways can also contribute pollutant loading under dry conditions. Improvements to riparian corridor conditions may also improve dissolved oxygen and reduce excess sediment in the stream by providing more stability for reducing channel erosion, reducing inputs from overland runoff, and providing shade that can reduce stream temperatures.

6.2.1 Agricultural Stormwater Runoff

Background: Stormwater runoff from agricultural lands, such as pastures used for livestock grazing or croplands, may contribute pollutant loads to surface waters in the Bear Creek watersheds. Land cover data indicate that agricultural practices occurring within riparian corridors may be areas of special concern as influences to surface water quality may be more directly impacted.

Objective: The implementation of BMPs that reduce soil erosion or the movement of fertilizers and organic materials from fields or application sites will provide the greatest benefits in reducing pollutant loading from agricultural lands. Additionally, minimizing or eliminating livestock accessibility to streams can also reduce nonpoint source pollutant loading by reducing waste from being deposited directly into the waterway. Installing BMPs on highly responsive areas (HRA) may produce the greatest benefit to water quality (Figure 3). The information provided by this map should be supplemented with local knowledge of the watershed in order to identify “critical areas” for BMP implementation and Section 319 funding. Until such time when critical areas have been identified, priority for BMP implementation should be given to areas identified as being highly responsive or that are within the riparian corridors of streams in the Bear Creek watershed.

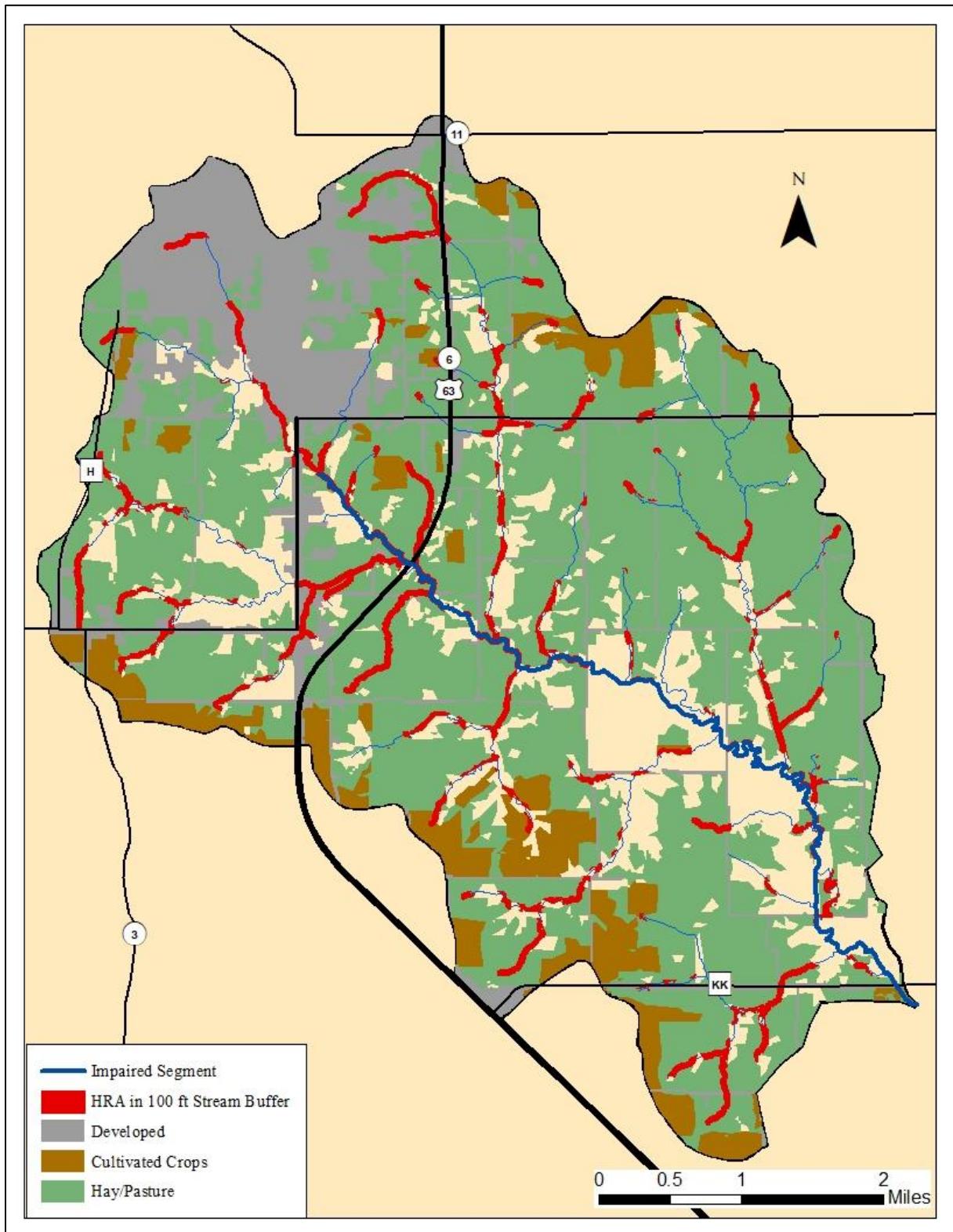


Figure 3. Areas likely to be highly responsive to BMP implementation

Strategy 1: In Missouri, the Soil and Water Conservation Program provides assistance and cost sharing opportunities to farmers and landowners willing to implement practices designed to, among other things, address grazing systems, animal waste management, soil erosion, and the protection of water quality. An online directory of the soil and water conservation districts in Missouri is available at <http://mosoilandwater.land/>. Table 4 presents a list of available cost-share conservation practices that may reduce sediment and nutrient loading to surface waters. Table 5 presents a list of those cost-share practices already implemented within the Bear Creek watershed.

Table 4. Soil and Water Conservation Program Cost-Share Practices

Cost-Share No.	Practice	Mode of Action			Pollutant Addressed	
		Avoid	Control	Trap	Sediment	Nutrients
DSL-01	Permanent Vegetative Cover Establishment	X	X	X	X	X
DSL-02	Permanent Vegetative Cover Improvement	X	X	X	X	X
DSL-04	Terrace System		X	X	X	X
DSL-44	Terrace System with Tile		X		X	X
DSL-05	Diversion		X		X	X
DSL-11	Permanent Vegetative Cover - Critical Area	X	X	X	X	X
DSL-111	Permanent Vegetative Cover - Critical Area: Confined Animal Feedlot	X	X	X	X	X
DSL-15	No-Till System	X	X	X	X	X
DWC-01	Water Impoundment Reservoir		X	X	X	X
DWP-01	Sediment Retention, Erosion or Water Control Structure		X	X	X	X
DWP-03	Sod Waterway	X	X	X	X	X
N332	Contour Buffer Strips	X	X	X	X	X
N340	Cover Crop	X	X	X	X	X
N380	Windbreak/Shelterbelt Establishment	X	X	X	X	X
N410	Drop Pipe		X	X	X	X
N585	Contour Stripcropping		X	X	X	X
DSP-02	Permanent Vegetative Cover Enhancement	X	X	X	X	X
DSP 3.1	Grazing System Water Development		X		X	X
DSP 3.2	Grazing System Water Distribution		X		X	X
DSP 3.3	Grazing System Fence	X	X		X	X
DSP 3.4	Grazing System Lime		X			X
DSP 3.5	Grazing System Seed	X	X	X	X	X
N430	Irrigation Water Conveyance		X		X	X
N442	Irrigation System, Sprinkler	X			X	X
N443	Irrigation System, Surface and Subsurface		X		X	X
N447	Irrigation System, Tail Water Recovery		X		X	X
N554	Drainage Water Management		X	X	X	X
N587	Structure for Water Control		X	X	X	X
N312	Beef Waste Management System	X	X			X
N312	Dairy Waste Management System	X	X			X
N312	Poultry Waste Management	X	X			X
N312	Swine Waste Management	X	X			X

Cost-Share No.	Practice	Mode of Action			Pollutant Addressed	
		Avoid	Control	Trap	Sediment	Nutrients
N316	Incinerator	x	x			x
N317	Composting Facility	x	x			x
N590	Nutrient Management	x	x		x	x
C650	Streambank Stabilization		x	x	x	x
DSP-31	Sinkhole Improvement		x	x	x	x
BDSP-31	Buffer Sinkhole Improvement		x	x	x	x
N351	Well Decommissioning	x			x	x
N380	Windbreak/Shelterbelt Establishment	x	x	x	x	x
N386	Field Border		x	x	x	x
N391	Riparian Forest Buffer		x	x	x	x
N393	Filter Strip		x	x	x	x
N574	Spring Development	x			x	x
N725	Sinkhole Treatment	x	x	x	x	x
WQ10	Stream Protection	x	x	x	x	x

Table 5. Implemented Soil and Water Conservation Program Cost-Share Practices

Cost-Share No.	State Fiscal Year	Practice	No. of Practices	Extent Installed
DWP-01	2016	Sediment Retention, Erosion or Water Control Structure	1	2,351 cubic yards
N340	2017	Cover Crop	3	363 acres
N340	2019	Cover Crop	3	161 acres

Strategy 2: Any voluntary BMP that is implemented to control erosion or limit the movement of fertilizers or animal manure from agricultural land can aid in reducing pollutant loading of nutrients or oxygen consuming substances. Table 6 presents examples of common BMPs that address agricultural runoff and where they may be used. Some of these BMPs may be similar or the same as those available through the cost-share program. BMPs placed in locally identified critical areas or in the highly responsive areas identified in this document will provide the greatest water quality benefits.

Table 6. BMPs to address agricultural runoff in the Bear Creek watershed

Best Management Practice	Description	BMP-Type
Cover crops	Vegetation planted to reduce surface erosion after harvest until the next crop	Cropland
Nutrient management plans	A plan to manage the amount, placement, and timing of applications of fertilizers	Cropland
Conservation crop rotation	Various crops grown on the same land in a planned rotation, which reduces erosion	Cropland
Grassed waterways	A grassed strip to convey water and prevent gully formation	Cropland
Terraces	An earth embankment across the slope of a field to intercept runoff and trap soil	Cropland

Best Management Practice	Description	BMP-Type
Vegetative Buffers	Permanently vegetated areas that reduce sediment loss	Cropland
Water retention structures	Structures to control runoff and prevent erosion	Cropland
Off-stream watering systems	Livestock watering systems located away from streams or ponds, which reduces the time livestock spend in a stream	Livestock
Rotational grazing	Rotating livestock within a pasture to spread manure more uniformly and allows vegetation to rest and regenerate	Livestock
Relocate pasture feeding sites	Move feeding sites away from streams to reduce manure near stream	Livestock
Grazing management plans	A plan designed to avoid over grazing, and subsequent erosion	Livestock
Relocate feeding pens	Move feeding pens away from streams to reduce manure near stream	Livestock
Fence off streams and ponds	Prevent livestock from entering water ways	Livestock
Vegetative filter strips	Vegetated areas that receive runoff from crop and animal operations	Livestock

6.2.2 Onsite Wastewater Treatment Systems

Background: Failing onsite wastewater treatment systems (e.g., septic systems) may be sources of nutrients or oxygen demanding substances to nearby waterways during periods associated with either wet weather or dry weather flows depending upon the nature of the failure.

Objective: By design, properly functioning onsite wastewater treatment systems should not be contributing significant pollutant loads to surface waters. For this reason, the TMDL assigns a load allocation of zero to these potential sources during critical low flow conditions. Proper maintenance of onsite wastewater treatment systems including septic tanks, associated drain fields, and household lagoons is the primary BMP for limiting pollutant inputs from these sources.

Strategy 1: Educate homeowners about proper onsite wastewater treatment system maintenance. This may be provided by local governments, local watershed groups, or university extension offices. The EPA maintains various guidance documents and resources pertaining to onsite treatment systems including the *Homeowner's Guide to Septic Systems* online at water.epa.gov/infrastructure/septic/homeowner-resources.cfm. For onsite wastewater treatment systems that are already failing, repair, or replacement of the system is necessary.

Strategy 2: Any local ordinances regarding permitting requirements pertaining to repairs, replacement, or the installation of new systems must be followed.

Strategy 3: Consideration should be given to reducing reliance on onsite systems in favor of centralized systems. Homeowners and local governments should explore the potential elimination of onsite systems and connection to existing sewer systems. Elimination of any

onsite wastewater treatment systems in the watershed is expected to result in pollutant loading reductions.

6.2.3 Riparian Corridor Conditions

Background: Wooded riparian buffers are a vital functional component of stream ecosystems and are instrumental in the detention, removal, and assimilation of nutrients and sediment before they reach surface waters. Wooded riparian corridors can also provide shading that reduces stream temperatures, which can increase the dissolved oxygen saturation capacity of the stream. However, during some periods falling leaves may contribute organic loading to the stream and increase overall oxygen demand.

Objective: The TMDL for Bear Creek is not written to address the physical characteristics of the stream or its adjoining habitat. However, improvement or maintenance of existing riparian corridors can result in conditions that will aid the stream in achieving the applicable dissolved oxygen criterion. Note that pollutant loading from riparian areas are a component of the TMDL allocations and can be addressed appropriately through the implementation practices described in other sections of this document as they pertain to specific runoff sources, such as areas having agricultural or urban land uses.

Strategy: Establish or maintain trees and shrubs located adjacent to streams. Tree canopy cover can create shade to lower water temperatures. Cooler water can hold more dissolved oxygen than warmer water. Additionally, a forested riparian corridor can reduce the amount of sediment, organic material, and nutrients in surface runoff. Dominant vegetation should consist of native species that are capable of naturally regenerating and that are well suited for local soil and hydrologic conditions. The U.S. Department of Agriculture, through the U.S. Forest Service, provides technical guidance on this strategy online at www.srs.fs.usda.gov/pubs/33522 and through the Natural Resources Conservation Service at www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/cp/ncps/.

7. Costs of Implementation and Potential Funding Sources

TMDLs are written to meet applicable water quality standards per federal regulations at 40 CFR 130.7(c)(1). As a result, they are developed without considerations of cost or available treatment technologies. However, facility upgrades and BMP installations result in real-world costs that need to be considered before determining what technologies or actions to employ in order to meet the calculated water quality targets. In many cases, TMDL implementation is partially a continuation of already permitted activities and costs are incurred as part of the normal operation and maintenance of those permitted systems. Other point source costs may arise as a result of needed facility upgrades in order to meet specified permit limits or conditions. For nonpoint sources, costs associated with installing and maintaining BMPs or with the maintenance, repair, or replacement of onsite wastewater treatment systems depend upon the type, number, and complexity of the practice or repair. Fortunately, a single BMP may address several pollutants or degradation pathways, thereby compensating for the overall costs by providing additional water quality benefits. Estimates of BMP costs are available online from the International Stormwater BMP Database at bmpdatabase.org.

To offset costs associated with facility upgrades or BMP implementation, a variety of grants and loan programs are available to assist watershed stakeholders. The most commonly used sources of funding are low-interest loans through the State Revolving Fund, Section 319 subgrants, and cost-share practices through the state's Soil and Water Conservation Program.

Low-interest loans from the Clean Water State Revolving Fund are available through the Department's Water Protection Program Financial Assistance Center. The State Revolving Fund provides subsidized loans to municipalities, counties, public sewer districts, and political subdivisions for wastewater infrastructure projects. Loans may be paired with grant funds for qualifying communities. Information on the Department's grant policy is available online at dnr.mo.gov/env/wpp/srf/wastewater-assistance.htm. Eligible projects include new construction or improvement of existing facilities. More information regarding the State Revolving Fund Program is available online at dnr.mo.gov/env/wpp/srf/index.html.

The Missouri Agricultural and Small Business Development Authority offers an Animal Waste Treatment System Loan Program in cooperation with the Clean Water State Revolving Fund. Animal Waste Treatment Loans Program may finance eligible animal waste treatment systems for independent livestock and poultry producers with operations of less than 1,000 animals. Eligible costs include storage structures, land, dedicated equipment, flush systems, composters, and more. More information regarding the Animal Waste Treatment Loans Program is available online at agriculture.mo.gov/abd/financial/awloanprg.php.

By amendment to the federal Clean Water Act in 1987, the Section 319 grant program was established to provide funding for efforts to reduce nonpoint source pollution. EPA provides 319 funding to the state, which in turn allocates a portion of the funding as subgrants to public and non-profit organizations to address nonpoint source concerns. Section 319-funded subgrants may be used to demonstrate innovative BMPs, support education and outreach programs, restore impaired waters, or protect waters from becoming impaired. More information regarding the Section 319 Nonpoint Source Implementation Program is available online at dnr.mo.gov/env/swcp/nps/index.html.

The Soil and Water Conservation Program provides financial incentives to landowners to implement practices that help prevent soil erosion and protect water quality. The program offers cost-share practices through its county conservation districts. Landowners may receive up to 75 percent reimbursement of the estimated cost of a practice through the program. The primary funding for cost-share practices from the Soil and Water Conservation Program comes from the one-tenth-of-one percent Parks, Soils, and Water Sales Tax. More information regarding the Soil and Water Conservation Program and cost-share practices is available online at dnr.mo.gov/env/swcp/service/swcp_cs.htm.

In addition to state sources of funding, federal assistance, public bonds, and private financing may also be available for TMDL implementation. For example, the U.S. Department of Agriculture through its Natural Resources Conservation Service provides various incentive and financial assistance programs for implementing BMPs that reduce pollutant loading from agricultural areas. Additionally, the EPA maintains the Catalog of Federal Funding, which is a

searchable database for other financial assistance sources. Table 7 provides links to these as well as other federal funding sources.

Table 7. Online resources for potential funding sources

Name and URL	Description
U.S. Department of Agriculture Natural Resources Conservation Service https://www.nrcs.usda.gov/wps/portal/nrcs/site/mo/home/	Financial assistance and incentives to implement voluntary BMPs <ul style="list-style-type: none"> ◦ Environmental Quality Incentives Program (EQIP) ◦ Regional Conservation Partnership Program (RCPP) ◦ Conservation Stewardship Program (CSP) ◦ Agricultural Conservation Easement Program (ACEP)
Wichita State University, Environmental Finance Center (EFC) https://www.wichita.edu/academics/fairmount_college_of Liberal_arts_and_sciences/hugowall/xfc/news/meramec-funding-sources-landing-page.php	Searchable database of funding opportunities
Catalog of Federal Funding https://www.epa.gov/waterdata/catalog-federal-funding	Searchable database for financial assistance sources
Nonpoint Source – Related Funding Opportunities http://water.epa.gov/polwaste/nps/funding.cfm	List of federal websites with information regarding funding opportunities
Environmental Education Grants http://www2.epa.gov/education/environmental-education-ee-grants	Financial support for environmental education projects
Environmental Justice Grants https://www.epa.gov/environmentaljustice/environmental-justice-grants-and-resources	Grant resources for Environmental Justice communities
Water Infrastructure and Resiliency Finance Center https://www.epa.gov/waterfinancecenter	Provides financing information for drinking water, wastewater and stormwater decisions
Grants.gov http://www.grants.gov	A common website for federal agencies to post funding opportunities

8. Measurable Goals, Timeline, and Milestones

TMDL implementation uses an adaptive management process that makes progress toward achieving water quality goals while using any new information to reduce uncertainty and adjust implementation activities. Timelines and interim milestones for reaching goals are adjustable and vary depending upon the means of implementation, as well as the strategies used to address individual point or nonpoint sources.

8.1 Point Source Implementation

When appropriate, federal regulations at 40 CFR §122.47 allow a permit to specify a schedule of compliance. Any schedule of compliance included in a permit for meeting final effluent limits will serve as the primary timeline and goals for implementing the TMDL as it pertains to point source dischargers. If applicable, any schedules identified in compliance agreements, court orders, or other enforcement actions will also serve as a timeline for point source TMDL implementation.

8.2 Nonpoint Source Implementation

The inclusion of timelines, milestones, and measurable goals is a required element for watershed-based plans developed with Section 319 funding and support. Any 319-funded watershed-based management plans developed for the Bear Creek watershed or any subwatersheds therein should incorporate the goals established in the approved 2019 Revised TMDL for nutrients and BOD. These plans should also contain various milestones and implementation goals for conservation practices, as well as educational targets. Once developed, the schedules outlined in those plans will serve as a schedule for TMDL implementation as it pertains to nonpoint sources.

9. Conclusion

The purpose of this TMDL implementation strategies document is to serve as a general guide to Department staff, soil and water conservation districts, local governments, permitted entities, watershed managers, and citizen groups for reducing existing pollutant loads to restore Bear Creek to conditions that attain water quality standards. The ultimate goal is to meet Missouri Water Quality Standards through attainment of the minimum dissolved oxygen criterion for the protection of aquatic life in warm water habitats of 5.0 mg/L. Implementation should follow an adaptive implementation approach that makes progress toward achieving water quality goals while using new data and information to reduce uncertainty and adjust implementation activities. Implementation efforts are expected to occur over a number of years, but within the schedules established in state operating permits and Section 319 watershed-based plans. Success in achieving water quality standards will be determined by the Department through biennial assessments of water quality compliance as required by Sections 305(b) and 303(d) of the Clean Water Act.

The Department has an administrative record on file for the Revised Bear Creek TMDL. The record contains this implementation strategies document and any studies, data or calculations on which loading targets are based. This information is available upon request to the Department at dnr.mo.gov/sunshine-form.htm. Any request for information about this TMDL will be processed in accordance with Missouri's Sunshine Law (Chapter 610, RSMO) and the Department's administrative policies and procedures governing Sunshine Law requests. For more information about open record/Sunshine requests, please consult the Department's website at dnr.mo.gov/sunshinerequests.htm.

This implementation strategies document is scheduled for a 45-day public notice and comment period in conjunction with the comment period for the 2019 revised Bear Creek TMDL. Any comments received, as well as the Department's responses to those comments, will be maintained on file with the Department and posted online at

dnr.mo.gov/env/wpp/tmdl/0115u-01-bear-ck-record.htm. The Department maintains an email distribution list for notifying subscribers of significant TMDL updates or activities. Those interested in subscribing to these TMDL updates can submit their email address using the online form at public.govdelivery.com/accounts/MODNR/subscriber/new?topic_id=MODNR_177.

10. References

FGDC (Federal Geographic Data Committee). 2003. FGDC Proposal, Version 1.1, Federal Standards for Delineation of Hydrologic Unit Boundaries. December 23, 2003.

Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K., 2015, Completion of the 2011 National Land Cover Database for the conterminous United States—Representing a decade of land cover change information. Photogrammetric Engineering and Remote Sensing, v. 81, no. 5, p. 345-354.

USGS (U.S. Geological Survey). 2019. Hydrologic Unit Maps. [Online WWW] Available URL: <https://water.usgs.gov/GIS/huc.html> [Accessed 2019].

Appendix A

Nine Key Elements Critical to a Watershed Management Plan

- a. An identification of the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in this watershed-based plan (and to achieve any other watershed goals identified in the watershed-based plan, as discussed in item (b) immediately below). Sources that need to be controlled should be identified at the significant subcategory level with estimates of the extent to which they are present in the watershed (e.g., X number of dairy cattle feedlots needing upgrading, including a rough estimate of the number of cattle per facility; Y acres of row crops needing improved nutrient management or sediment control; or Z linear miles of eroded streambank needing remediation).
- b. An estimate of the load reductions expected for the management measures described under paragraph (c) below (recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time). Estimates should be provided at the same level as in item (a) above (e.g., the total load reduction expected for dairy cattle feedlots; row crops; or eroded streambanks).
- c. A description of the nonpoint source management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above (as well as to achieve other watershed goals identified in this watershed-based plan), and an identification (using a map or a description) of the critical areas in which those measures will be needed to implement this plan.
- d. An estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan. As sources of funding, States should consider the use of their Section 319 programs, State Revolving Funds, U.S. Department of Agriculture's Environmental Quality Incentives Program and Conservation Reserve Program, and other relevant Federal, State, local and private funds that may be available to assist in implementing this plan.
- e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the nonpoint source management measures that will be implemented.
- f. A schedule for implementing the nonpoint source management measures identified in this plan that is reasonably expeditious.
- g. A description of interim, measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.
- h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether this watershed-based plan needs to be revised or, if a nonpoint source TMDL has been established, whether the nonpoint source TMDL needs to be revised.
- i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.